(12) UK Patent Application (19) GB (11) 2 108 857 A

(21) Application No 8231368
(22) Date of filing 3 Nov 1982
(30) Priority data
(31) 8133657
(32) 7 Nov 1981
(33) United Kingdom (GB)
(43) Application published
25 May 1983
(51) INT CL³
A63H 33/10
(52) Domestic classification
A6S 6C1B 6D 6E2
(56) Documents cited
GBA 2074461
GBA 2049451
GBA 2041228
GB 1271675
GB 1238975
GB 0597762
GB 0589216
GB 0371638
GB 0202983
(58) Field of search
A6S
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(54) **Building toy system**

(57) A building toy system comprises a member 1 having two components 2 and 3, which are secured together to form a structurally bonded joint 4, and having each opposite pair of faces interconnected by at least one through-hole 6, 9 or 10. A minimum of material is at the intersection between the through-holes 9 and 10, and this leads to point contact between orthogonally arranged securing means 12, e.g. rods, dowels or pegs, and helps to increase the frictional fit of the securing means within the through-holes.

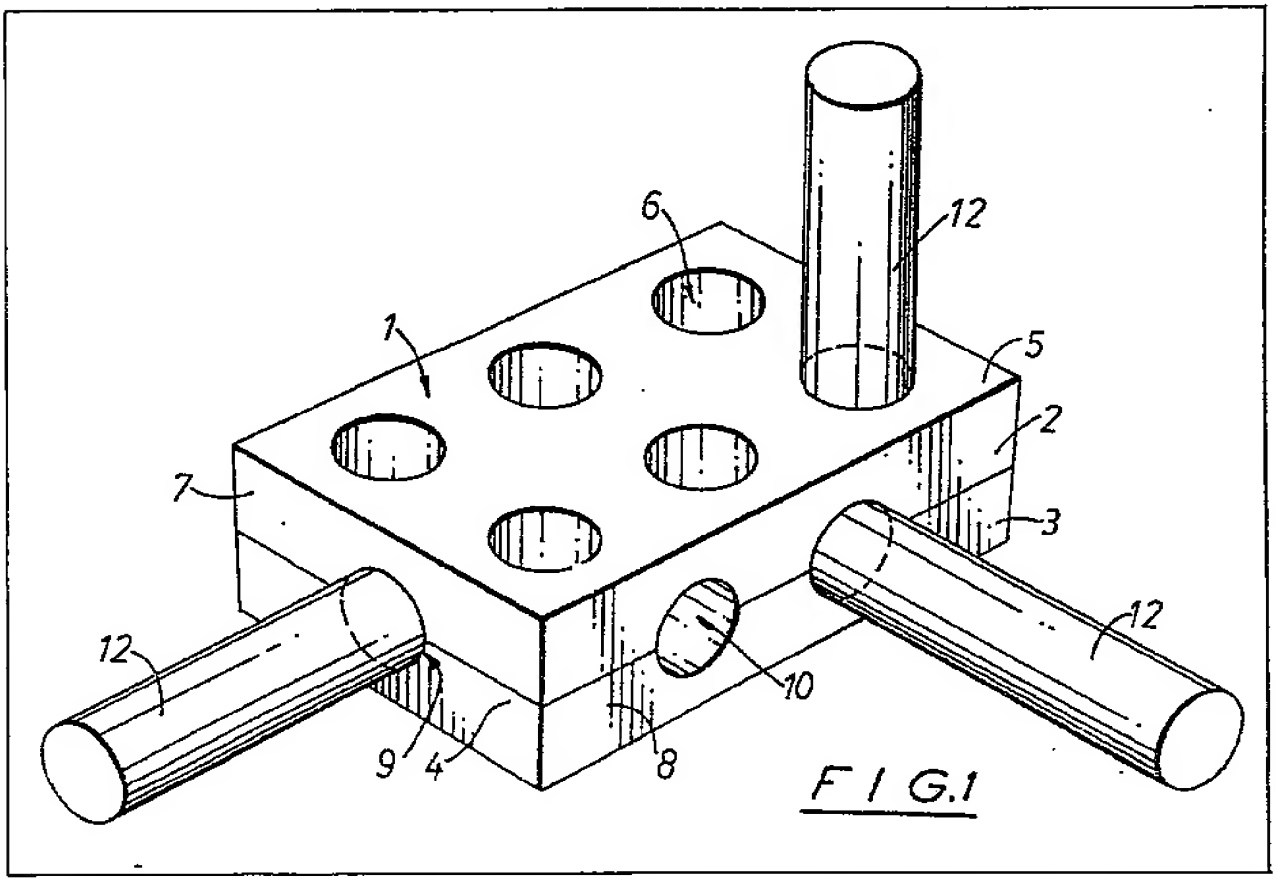

FIG.1

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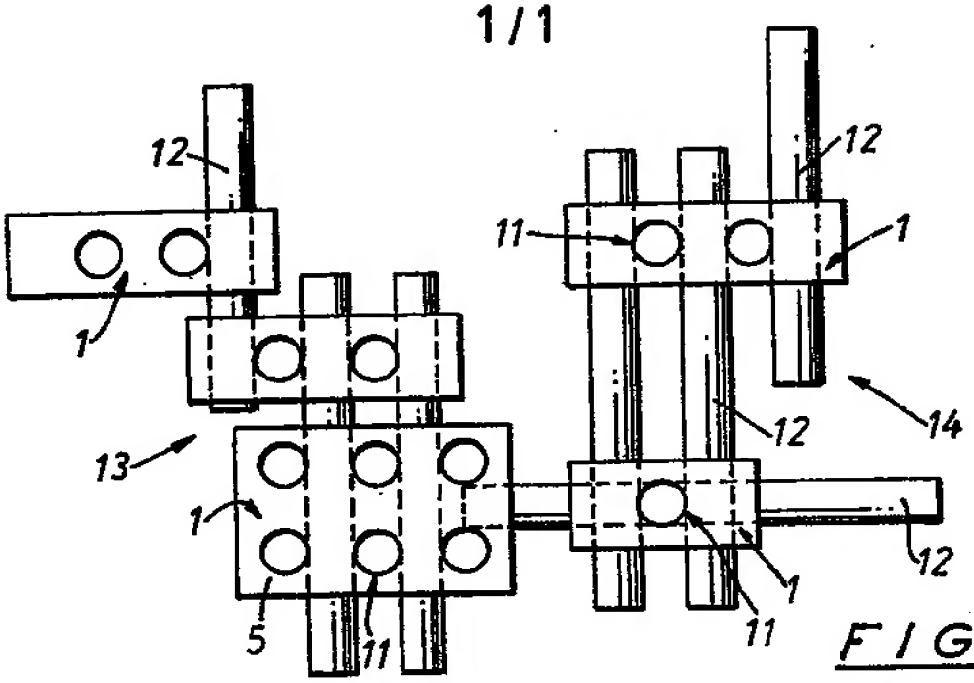

FIG.2

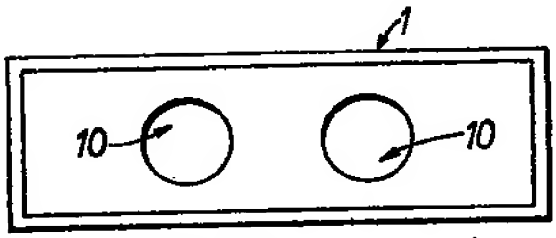

FIG.3

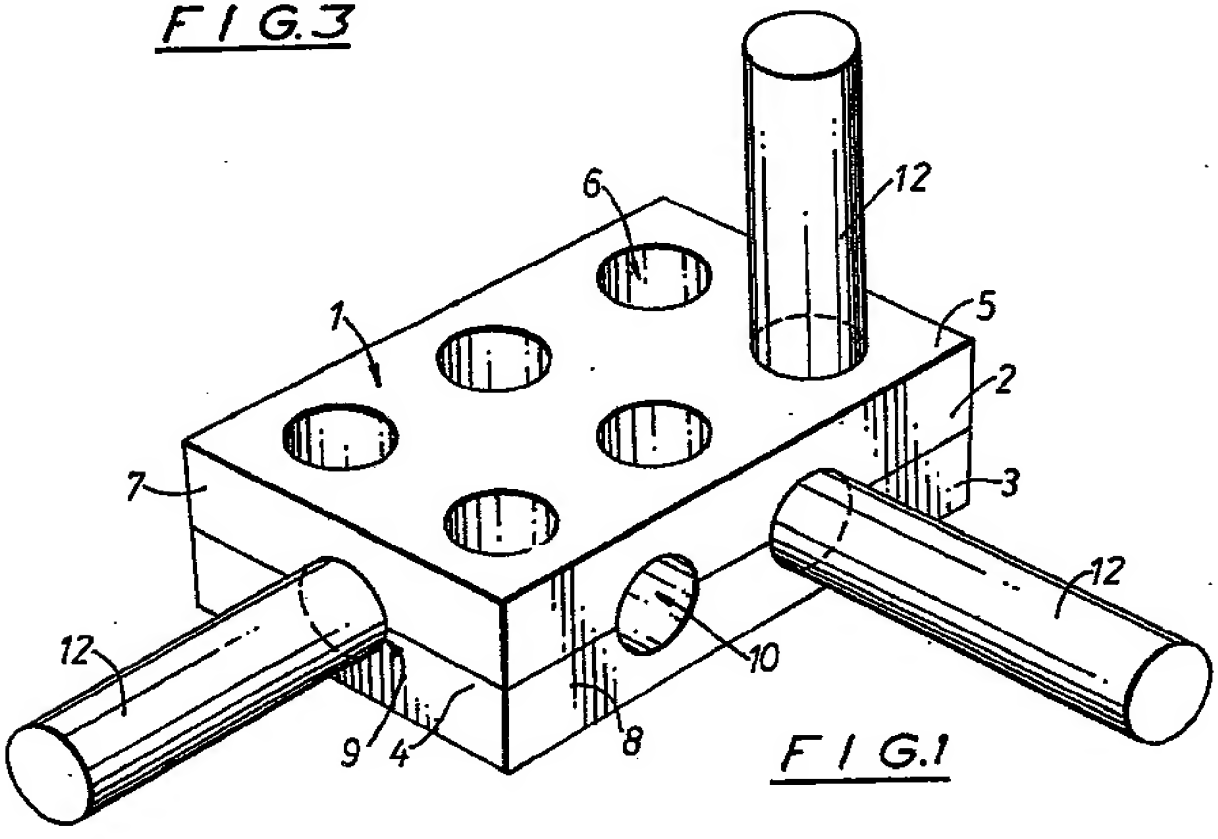

FIG.1

SPECIFICATION

Building toy system

This invention relates to a building toy system of the type having modular units.

It is known to have a building toy system in which the modular units are capable of being assembled into a structural solid. However, such building toy systems allow for an assembly to be built on only two of the major axes of each modular unit.

According to a first aspect of the present invention, there is provided a building toy system which comprises a modular member adapted for securement relative to at least one further modular member in any one of three directions, which may or may not be orthogonally arranged with respect to each other. The directions may conveniently be along or parallel to the three major axes of a cuboid modular member to form an assembly.

The assembly may be formed as a structural solid with modular members arranged adjacently to each other, or as a space-frame with the modular members spaced apart from each other.

Each member may be a rectangular parallelepiped (i.e. a cuboid) or a cube.

It is preferred that the modular member has each opposite pair of faces of said member interconnected by at least one through-hole extending between said faces. One opposite pair of faces has through-holes arranged in m rows and n columns. Other opposite pairs of faces have m-1 and n-1 through-holes respectively located between rows and columns of the m × n array of the one opposite pair of faces.

Preferably, the m × n array has 2 rows and 3 columns i.e. the one opposite pair of faces has six through-holes. The other opposite pairs of faces have two and one through-holes respectively.

Each member is preferably adapted for securement to at least one further adjacent member by securing means which fit the at least one through-hole in each member and hence secure the members together.

The securing means may be rods, dowels or pegs which are adapted for frictional engagement within the at least one through-hole in each member.

There may be an absolute minimum of material at the points of intersection between the m-1 and n-1 through-holes of said other opposite pairs of faces and the m and n through-holes of the one opposite pair of faces. The absolute minimum of material may lead to point contact between the securing means which frictionally engage within said through-hole.

Each member is preferably made from wood or a synthetic polymeric material such as a thermoplastic material. A preferred thermoplastic material is a medium impact food approved polymer, such as acrylonitrile/butadiene/styrene. The securing means is preferably made from wood or a synthetic polymeric material, such as a thermoplastic material.

According to a second aspect of the present invention, there is provided a method of making a modular member adapted for securement relative to at least one further modular member within a building toy system which comprises forming two diametrically opposed matching compositions and attaching the components to each other to form a single modular member.

The two diametrically opposed matching components are preferably formed by injection moulding a synthetic polymeric material, such as a thermoplastic material, at a moulding temperature of approximately 220°C and an injection force of 57 KN. A preferred theremoplastic material is a medium impact food approved polymer, such as acrylonitrile/butadiene/styrene. The thermoplastic material has a preferred melt flow index of between 1.5—2.0 grams per 10 minutes.

The two diametrically opposed matching components are preferably attached to each other by ultrasonically welding to form a structurally bonded joint. The joint is preferably assisted by male/female connecting means, for example cooperating studs and holes, at least at the corners of each component, and preferably at a medial position between the corners. Each component preferably provides both male and female connecting means, for example three studs and three holes. The cooperating means also preferably assist in the registration of the two components together to provide accurately aligned through-holes. When the two components are registered together, an accurate weld may be produced.

The securing means for securing one modular member to at least one adjacent modular member may be formed by moulding or extruding a synthetic polymeric material, such as a thermoplastic material.

One embodiment of the invention will now be described by way of example with reference to the accompanying drawings in which:—

Figure 1 is a perspective view of a modular member according to the invention with securing means fitted therein;

Figure 2 is a plan view showing on the left-hand side three modular members assembled as a solid and on the right-hand side two modular members assembled as a space-frame; and

Figure 3 is a side elevation of a modular member.

Figure 1 shows a modular member 1 in the shape of a rectangular parallelepiped or cuboid. The member has two components 2 and 3 which are secured together to form a structurally bonded joint 4.

Each of the two components is formed by injection moulding a synthetic polymeric material, such as a thermoplastic material. The material, which is a medium impact food approved polymer, such as acrylonitrile/butadiene/styrene, is moulded at a moulding temperature of approximately 220°C. The injection force in the injection mould is 57 KN, and the thermoplastic material has a melt flow index of between

1.5—2.0 grams per 10 minutes.

The two components 2 and 3, which are diametrically opposed relative to each other, are removed from the mould and welded together ultrasonically to form the member 1 having the structurally bonded joint 4. The ultrasonic welding uses a 400 watt ultrasonic generator together with a booster and a Type 7200—2863 Titanium welding horn.

The member 1 has one opposite pair of faces i.e. major faces which have through-holes 6 arranged in an array of m rows and n columns. Figure 1 shows the major faces 5 having an array of 2 rows by 3 columns. The other opposite pairs of faces i.e. the end faces 7 and side faces 8 have m-1 and n-1 through-holes respectively. Figure 1 shows the end faces 7 having one through-hole 9 and the side faces 8 having an array of 1 row by 2 columns. The major faces 5 have six through-holes 6 and the side faces 8 have two through-holes 10.

The through-holes 9 and 10 are formed as open channels during the moulding of the two components 2 and 3 and form enclosed through-holes when the two components 2 and 3 are welded together. The through-holes 6 are formed during the moulding of the two components 2 and 3. Instead of forming the through-holes during the moulding step, it is of course possible that they may be formed by drilling through a preformed solid member 1.

Figure 2 shows that at each intersection 11 between the through-holes 9 and 10 of the end faces 7 and side faces 8 respectively and the through-holes 6 of the major faces 5 there may be an absolute minimum of material of the member. This may lead to point contact between securing means which are within the through-holes and are arranged at right-angles to each other. The point contact between adjacent intersections securing means helps to increase the frictional fit of the securing means within the through-holes.

As the through-holes 9 and 10 are located between the rows and columns of the through-hole 6, each member is compact and hence can be made using an absolute minimum of material.

Figure 1 shows the securing means used in the invention. Three rods, dowels or pegs 12 frictionally engage within the through-holes 6, 9 and 10. The pegs 12 are push-fitted into each through-hole. The lengths of the pegs 12 can vary, depending on whether a solid assembly is required with individual members adjacently arranged with respect to each other (left-hand side of Figure 2) or a space-frame is required with the individual members spaced apart by the pegs (right-hand of Figure 2). The pegs 12 can be made from a synthetic polymeric material, such as a thermoplastic material, or a material such as wood. If made from a synthetic polymeric material, the pegs can be either moulded or extruded.

It can thus be seen that the modular members 1 can be assembled together to form a building toy system as either a structural solid 13 (as shown on the left-hand side of Figure 2) or a space-frame 14 (as shown on the right-hand side of Figure 2). The system can be added to in any one of three directions, which may or may not be orthogonally arranged with respect to each other. The directions may be along or parallel to the three major axes of a cuboid modular member (as shown in the accompanying drawings). The assembly of the modular members in any one of three directions according to the invention is advantageous over known building toy systems, which only allow for an assembly to be built in only two directions.

Whilst the invention has been described with reference to thermoplastic material, it is possible to use wooden modular members suitably treated to avoid splinter penetration of, for example, childrens' fingers.

As well as being a toy, the invention can be used didactically to enable children or mentally handicapped children to get a better understanding of a three-dimensional spatial concept. Each modular member can be of course be produced in any particular colour to provide an attractive building toy system for children to play with or for use as a teaching aid.

CLAIMS

1. A building toy system comprising a modular member adapted for securement relative to at least one further modular member in any one of three directions, which may or may not be orthogonally arranged with respect to each other.

2. A system as claimed in claim 1, wherein the directions are along or parallel to the three major axes of a cuboid modular member to form an assembly.

3. A system as claimed in claim 2, wherein the assembly is formed as a structural solid with modular members arranged to each other, or as a space-frame with the modular members spaced apart from each other.

4. A system as claimed in any one of claims 1 to 3, wherein each member is a rectangular parallelepiped or a cube.

5. A system as claimed in any one of claims 1 to 4, wherein the modular member has each opposite pair of faces of said member interconnected by at least one through-hole extending between said faces.

6. A system as claimed in claim 5, wherein one opposite pair of faces has through-holes arranged in m rows and n columns, other opposite pairs of faces having m-1 and n-1 through-holes respectively located between rows and columns of the m × n array of the one opposite pair of faces.

7. A system as claimed in claim 6, wherein the m × n array has 2 rows and 3 columns, the one opposite pair of faces having six through-holes and the other opposite pairs of faces having two and one through-holes respectively.

8. A system as claimed in claim 5, 6 or 7, wherein each member is adapted for securement to at least one further adjacent member by securing means which fit the at least one through-

hole in each member and hence secure the members together.

9. A system as claimed in claim 8, wherein the securing means are rods, dowels or pegs which are adapted for frictional engagement within the at least one through-hole in each member.

10. A system as claimed in claim 6, wherein there is an absolute minimum of material at the points of intersection between the m-1 and n-1 through-holes of said other opposite pairs of faces and the m and n through-holes of the one opposite pair of faces.

11. A system as claimed in claim 8, 9 or 10, wherein the absolute minimum of material leads to point contact between the securing means which frictionally engage with said through-hole.

12. A system as claimed in any one of the preceding claims, wherein each member is made from wood or a synthetic polymeric material, such as a thermoplastic material.

13. A system as claimed in claim 12, wherein the thermoplastic material is a medium impact food approved polymer, such as acrylonitrile/butadiene/styrene.

14. A system as claimed in claim 8, wherein the securing means are made from wood or a synthetic polymeric material, such as a thermoplastic material.

15. A building toy system substantially as herein described with reference to and as illustrated in the accompanying drawings.

16. A method of making a modular member adapted for securement relative to at least one further modular member with a building toy system comprising forming two diametrically opposed matching components and attaching the components to each other to form a single modular member.

17. A method as claimed in claim 16, wherein the two diametrically opposed matching components are formed by injection moulding a synthetic polymeric material, such as a thermoplastic material, at a moulding temperature of approximately 220°C and an injection force of 57 KN.

18. A method as claimed in claim 17, wherein the thermoplastic material is a medium impact food approved polymer, such as acrylontrile/butadiene/styrene.

19. A method as claimed in claim 17 or 18, wherein the thermoplastic material has a melt flow index of between 1.5—2.0 grams per 10 minutes.

20. A method as claimed in claim 16 or 17, wherein the two diametrically opposed matching components are attached to each other by ultrasonically welding to form a structurally bonded joint.

21. A method as claimed in claim 20, wherein the joint is assisted by male/female connecting means at least at the corners of each component.

22. A method as claimed in claim 21, wherein the male/female connecting means are also at a medial position between the corners of each component.

23. A method as claimed in claim 21 or 22, wherein the male/female connecting means are cooperating studs and holes.

24. A method as claimed in claim 21, 22 or 23, whereln each component provides both male and female connecting means, for example three studs and three holes.

25. A method as claimed in any one of claims 21 to 24, wherein the connecting means also assist in the registration of the two components together to provide accurately aligned through-holes.

26. A method as claimed in claim 25, wherein an accurate weld is produced when the two components are registered together.

27. A method as claimed in claim 16, wherein securing means for securing one modular member to at least one adjacent modular member are formed by moulding or extruding a synthetic polymeric material, such as a thermoplastic material.

28. A method substantially as herein described with reference to the accompanying drawings.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1983. Published by the Patent Office 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.